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LISTS OF SPECIES

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Reptiles of the Complexo Energético Fundão-Santa Clara, central-south region of Paraná state, southern Brazil

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Abstract: Lists of reptiles of localities in Paraná are still scarce and restricted to three works, developed in the central-north and eastern regions of the state. Herein we present a list of reptiles of the Complexo Energético Fundão-Santa Clara, located in the central-south region of Paraná. The study was carried out from May 2010 to March 2012. We recorded 31 species: 20 snakes, seven lizards, two amphisbaenians and two testudines. We hope through this work contribute to a greater knowledge of the reptilian fauna of the central-south region of Paraná.

Key words: reptiles, Complexo Energético Fundão-Santa Clara, Paraná, Southern Brazil

INTRODUCTION

Brazil, with all its territorial extent and diversity of biomes, is among the countries with the richest fauna of reptiles, recording currently 760 species occurring in their territory (Costa and Bérnils 2014). In the state of Paraná 154 species are recorded, including nine chelonians, one crocodilian, eight amphisbaenians, 25 lizards and 111 snakes (Bérnils et al. 2007).

The knowledge of the reptilian fauna of Paraná is based on several works, mainly represented by lists of reptiles collected in the state by foreigners in past decades (Boettger 1906; Bérnils and Moura-Leite 1990, 2010), citations of new records for the state (Moura-Leite et al. 1996), studies of geographic distribution (D'Amato 1991; Ribas and Monteiro Filho 2002; Bérnils et al. 2007) and lists of endangered species (Morato et al. 1995; Bérnils et al. 2004). However, publications of lists of reptiles of localities in Paraná are still scarce and restricted to only three works (Bernarde and Machado 2002, 2006; Oliveira and Oliveira 2014).

Bernarde and Machado (2002) presented a list of species recorded in the region of the municipality of Londrina, central-north of Paraná. Bernarde and Machado (2006) listed the squamate reptiles found in the Parque Estadual Mata dos Godoy, Londrina municipality. Oliveira and Oliveira (2014) presented a list of species of squamate reptiles recorded in the locality of Colônia Castelhanos, São José dos Pinhais municipality, eastern Paraná.

In this work we present a list of species recorded during the execution of a monitoring program of the reptiles fauna in the area of the Complexo Energético Fundão-Santa Clara (CEFSC), in central-south Paraná. In addition to the field inventory, we also included museum records coming mainly from the faunal rescues previously carried out on the local.

MATERIALS AND METHODS

Study area

The CEFSC is constituted of two hydroelectric power plants located sequentially in the Jordão River, tributary of the Iguaçu River, in the central-south region of Paraná state (Figure 1). The Santa Clara Hydroelectric Power Plant (UHE Santa Clara) is situated between the municipalities of Candói and Pinhão (25°38′57″ S, 051°56′22″ W), and the Fundão Hydroelectric Power Plant (UHE Fundão) between Foz do Jordão and Pinhão (25°41′53″ S, 052°00′04″ W). These hydroelectric power plants went into operation between the years 2005 (Santa Clara) and 2006 (Fundão). The region is within the Terceiro Planalto Paranaense geomorphological unit (Maack 1981) and is located in the Atlantic Forest domain, comprising an ecotone between two phytophysiognomies, Steppe and Araucaria Forest (Roderjan et al. 2002). The local climate is characterized according to the Cfb Köppen pattern, mesothermic humid subtropical, without a defined dry season, with mild summer and severe frosts (Cigolini et al. 2001).

Data Collection

The fieldwork was carried out every two months from May 2010 to March 2012, with duration of five days each phase. To the specimens record we used the following methods (Figure 1):

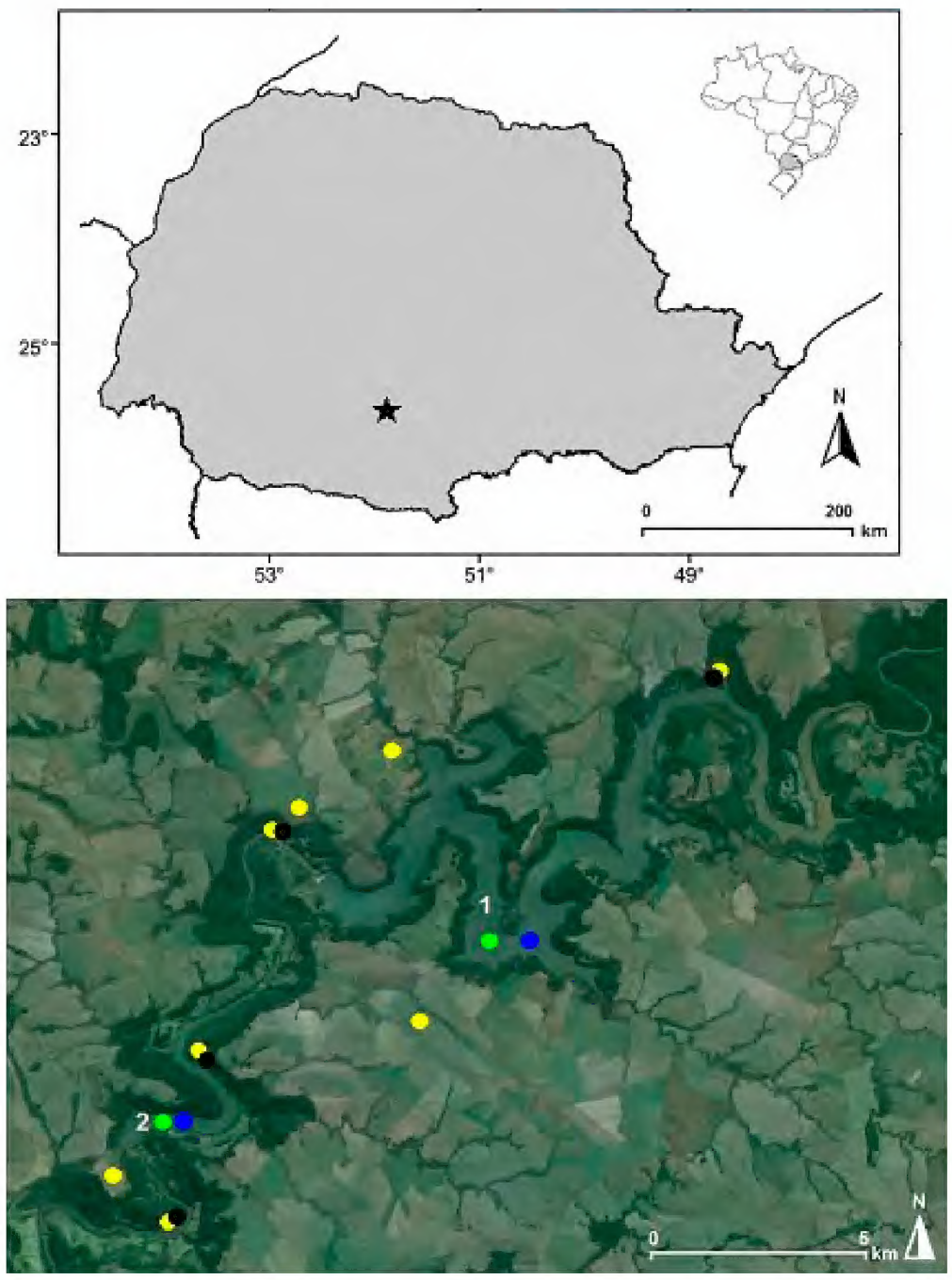

Figure 1. Map showing the location of the Complexo Energético Fundão-Santa Clara in the state of Paraná, southern Brazil (star). In the image the location of the Santa Clara Hydroelectric Power Plant (1), Fundão Hydroelectric Power Plant (2) and sampling sites (dots). Yellow dots represent sites sampled by active search, black dots represent sites sampled with pitfall traps, green dots represent sites sampled by search with boat and blue dots represent sites sampled with funnel traps (Image source: Google Earth™ 2013)

Active search (adapted of Franco et al. 2002): This method consisted in the search of the specimens in its natural habitats, in activity or not (under fallen logs, under rocks, holes in the ground, and others). In this method we also consider specimens found in the roads of area. The searches were carried out by two researchers, during eight hours a day (including the day and night periods), five days in each phase, totaling a sampling effort of 480 hours/man.

Pitfall traps (Corn 1994): Four sample areas were defined within riparian forest fragments, two above of each dam (near the reservoir) and two below (near the river). In each area six lines of traps spaced approximately 500 m apart were built. Each trap line was composed of four 60 L plastic buckets, buried 10 m apart and connected by a canvas fence about 0.8 m high. The traps were active for five days in each phase and were revised every morning. Total sampling effort of these traps was 5.760 buckets/day.

Search with boat in the reservoirs: To the record of aquatic species, especially chelonians, areas of the reservoirs were covered daily and alternately with aluminum boat and outboard motor at low speed in the morning, between 09:30 h and 12:00 h, and in the afternoon, between 13:30 h and 16:00 h. The animals were visually searched on the banks of reservoirs, on rocks, logs and in the water. This method totaled 300 hours of sampling.

Funnel traps (adapted of Fitch 1951): Consisted of cylinders (1.2 m × 0.5 m) partially floating made of plastic mesh, with an inverted funnel in one openings, destined the capture of aquatic chelonians. These traps were scattered in the two reservoirs (12 in Santa Clara and seven in Fundão), baited with fresh fish and revised daily, staying active for a period of about five consecutive days during each phase. Total sampling effort of these traps was 1.140 funnels/day.

Occasional records: Corresponded to the record of specimens by other researchers during the fieldwork, generally in roads of the area during displacements with car.

To complete the list of species we also used museum records, available in the herpetological collection of the Museu de História Natural Capão da Imbuia (MHNCI) at Curitiba, Paraná, coming mainly from the faunal rescues previously carried out in the study area (Appendix 1).

Species were identified in the field, based in Rhodin and Mittermeier (1983), Peters and Orejas-Miranda (1986), Lema (1994), Avila-Pires (1995), Silva Jr. and Sites Jr. (1999), Franco and Ferreira (2002), and Passos et al. (2010). The taxonomic nomenclature herein follows Uetz and Hosek (2015).

Species not previously recorded to the region, when possible, were collected (collection permit IBAMA number 073/2010), killed by cooling, fixed in a solution of 10% formalin, preserved in a 70% ethanol solution, and deposited in the herpetological collection of the MHNCI (Appendix 1).

RESULTS

A total of 31 species of reptiles were recorded at CEFSC, including 20 snakes: Colubridae (*n* = 1), Dipsadidae (14), Elapidae (1), Viperidae (3) and Anomalepididae (1); seven lizards: Leiosauridae (1), Tropiduridae (1), Gymnophthalmidae (1), Teiidae (2), Scincidae (1) and Diploglossidae (1); two Amphisbaenidae; and two Chelidae (Figures 2 and 3; Table 1).

The majority of the recorded species during the fieldwork was found in open areas, represented locally by pastures and plantations, through the active search. The species recorded in the forest edge were found mainly in small dirt roads that border or cross forest fragments.

DISCUSSION

The 31 species found represent 20% of the 154 species registered to the state of Paraná (Bérnils et al.

Figure 2. Some species of reptiles recorded at Complexo Energético Fundão-Santa Clara, state of Paraná, southern Brazil: **A**) *Hydromedusa tectifera*; **B**) *Phrynops williamsi* (Photo by L.R. Deconto); **C**) *Anisolepis grilli*; **D**) *Salvator merianae*; **E**) *Aspronema dorsivittatum*; **F**) *Ophiodes fragilis*; **G**) *Amphisbaena prunicolor*; **H**) *Atractus paraguayensis*; **I**) *Oxyrhopus clathratus*.

2007). The majority of the observed species present wide distribution along the state. Contrary, some are restricted to a few localities in Paraná, in this group are included *Contomastix vacariensis* and *Philodryas agassizii*. *Contomastix vacariensis* was recorded only in the study area and in the municipality of Tibagi, central-eastern Paraná (Bérnils et al. 2004; Souza-Filho 2013). *Philodryas agassizii* occurs in the study area and in the municipalities of Palmeira, Ponta Grossa and Porto Amazonas, southeastern of the state (Souza-Filho and Plombon 2014). The record of *Philodryas agassizii* in this study represented the rediscovery of this species in Paraná, 40 years after the last record and it expanded its occurrence for the central-south region of the state (Souza-Filho and Plombon 2014).

The majority of the species preferentially occupy open areas, many of them are typical of these formations, such as *Boiruna maculata*, *Bothrops alternatus*, *Contomastix vacariensis*, *Crotalus durissus*, *Oxyrhopus rhombifer*, *Paraphimophis rusticus*, *Philodryas agassizii* and *P. patagoniensis* (Bérnils et al. 2007). Especially *C. vacariensis*, is endemic of the high elevation grasslands of the southern region of Brazil (Souza-Filho 2013). The occurrence of these species in the area corroborates with the environmental profile of the region, represented predominantly by Steppe phytophisiognomy.

Two species recorded are threatened of extinction in Paraná, *Phrynops williamsi* and *Contomastix vacariensis* are categorized as "Vulnerable" in the state (Bérnils et al. 2004). *Contomastix vacariensis* also has been categorized as "Vulnerable" at national level (MMA 2014). Among the main threats to *P. williamsi* in Paraná is the construction of hydroelectric power plants, which affect the availability of food resources to species and alter the lotic regime of rivers (Bérnils et al. 2004). The main threats to *C. vacariensis* are the agricultural expansion, cattle ranching, the use of fire in the preparation of pastures, and the planting of exotic species (Bérnils et al. 2004). During the fieldwork only *P. williamsi* was observed in the area, has been found only in the Jordão River rocky bed, and not in the reservoirs.

Within of the CEFSC is located the Parque Estadual

Figure 3. Some species of reptiles recorded at Complexo Energético Fundão-Santa Clara, state of Paraná, southern Brazil: **A**) *Paraphimophis rusticus*; **B**) *Philodryas agassizii*; **C**) *Philodryas patagoniensis*; **D**) *Thamnodynastes hypoconia*; **E**) *Thamnodynastes strigatus*; **F**) *Micrurus altirostris*; **G**) *Bothrops jararaca*; **H**) *Crotalus durissus*; **I**) *Liotyphlops beui*.

de Santa Clara, a conservation unit of integral protection created in 2006 and situated just below the dam of the UHE Santa Clara. The Park area was sampled during the fieldwork, being record nine species: *Atractus paraguayensis*, *Bothrops alternatus*, *B. jararaca*, *Cercosaura schreibersii*, *Crotalus durissus*, *Micrurus altirostris*, *Paraphimophis rusticus*, *Salvator merianae* and *Thamnodynastes strigatus*.

Comparing the number of species of reptiles with three other localities studied in Paraná, the region of Londrina presents the highest species richness (42 species; Bernarde and Machado 2002), then CEFSC (31 species; present study), Parque Estadual Mata dos Godoy (23 species; Bernarde and Machado 2006) and Colônia Castelhanos (21 species; Oliveira and Oliveira 2014). However, the majority of these areas present distinct phytophysiognomies, the region of Londrina, including the Parque Estadual Mata dos Godoy, is represented by Semideciduous Forest, CEFSC by Steppe and Araucaria Forest, and Colônia Castelhanos by Ombrophilous Dense Forest.

Despite the significant species richness of reptiles found in Paraná, lists of species are still scarce in the state. We hope through this work contribute to a greater knowledge of the reptilian fauna of the central-south region of Paraná. We also emphasize the importance of more inventories in the state, as well as the effective publication of these studies.

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Table 1. Reptiles recorded at Complexo Energético Fundão-Santa Clara, central-south region of Paraná state, showing the habitat and the record type of the reptile species found in the area. Habitat: FE = forest edge; FO = forest (riparian forests); JR = Jordão River (rocky bed); OA = open areas (pastures and plantations); RE = reservoir. Record type: AS = active search; FT = funnel trap; MR = museum record; OR = occasional record; PT = pitfall trap.

Taxa	Habitat	Record type
Testudines		
Chelidae		
Hydromedusa tectifera Cope, 1869	RE	FT; MR
Phrynops williamsi Rhodin & Mittermeier, 1983	JR	AS
Squamata		
Leiosauridae		
Anisolepis grilli Boulenger, 1891	FO	PT; MR
Tropiduridae		
Tropidurus catalanensis Gudynas & Skuk, 1983	-	MR
Gymnophthalmidae		
Cercosaura schreibersii Wiegmann, 1834	FE	AS
Teiidae		
Contomastix vacariensis (Feltrim & Lema, 2000)	-	MR
Salvator merianae (Duméril & Bibron, 1839)	FE; FO; OA	AS; MR
Scincidae		
Aspronema dorsivittatum (Cope, 1862)	OA	AS
Diploglossidae		
Ophiodes fragilis (Raddi, 1826)	FE	AS; MR
Amphisbaenidae		
Amphisbaena microcephalum (Wagler, 1824)	-	MR
Amphisbaena prunicolor (Cope, 1885)	OA	AS
Colubridae		
Chironius bicarinatus (Wied, 1820)	-	MR
Dipsadidae		
Atractus paraguayensis Werner, 1924	FO	MR; PT
Boiruna maculata (Boulenger, 1896)	OA	AS; MR
Erythrolamprus miliaris (Linnaeus, 1758)	-	MR
Erythrolamprus poecilogyrus (Wied-Neuwied, 1825)	-	MR
Helicops infrataeniatus Jan, 1865	-	MR
Oxyrhopus clathratus Duméril, Bibron & Duméril, 1854	FO	AS; MR; PT
Oxyrhopus rhombifer Duméril, Bibron & Duméril, 1854	-	MR
Paraphimophis rusticus (Cope, 1878)	FE	AS; MR
Philodryas agassizii (Jan, 1863)	OA	OR
Philodryas olfersii (Lichtenstein, 1823)	-	MR
Philodryas patagoniensis (Girard, 1858)	OA	AS; MR; OR
Thamnodynastes hypoconia (Cope, 1860)	OA	AS
Thamnodynastes strigatus (Günther, 1858)	OA	AS; MR
Tomodon dorsatum Duméril, Bibron & Duméril, 1854	-	MR
Elapidae		
Micrurus altirostris (Cope, 1860)	FE; FO; OA	AS; MR; OR; PT
Viperidae		
Bothrops alternatus (Duméril, Bibron & Duméril, 1854)	OA	AS; MR
Bothrops jararaca (Wied, 1824)	FE; FO	AS; MR; OR; PT
Crotalus durissus Linnaeus, 1758	OA	AS; MR; OR
Anomalepididae		
Liotyphlops beui (Amaral, 1924)	FE	AS; MR

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Appendix 1. Reptiles from Complexo Energético Fundão-Santa Clara housed in the herpetological collection of the Museu de História Natural Capão da Imbuia (MHNCI).

Chelidae: *Hydromedusa tectifera* (MHNCI 5154); **Leiosauridae:** *Anisolepis grilli* (MHNCI 12453-12459, 12468, 12569, 12594-12598); **Tropiduridae:** *Tropidurus catalanensis* (MHNCI 12439, 12470); **Teiidae:** *Contomastix vacariensis* (MHNCI 11531), *Salvator merianae* (MHNCI 12330, 12331, 12333, 12435, 12436, 12448-12451, 12585-12593); **Diploglossidae:** *Ophiodes fragilis* (MHNCI 12392, 12460-12462, 12599-12605); **Amphisbaenidae:** *Amphisbaena microcephalum* (MHNCI 12393-12396); **Colubridae:** *Chironius bicarinatus* (MHNCI 12369); **Dipsadidae:** *Atractus paraguayensis* (MHNCI 5156, 11714, 12344, 12345, 12362-12367, 12371, 12372, 12378-12385, 12397-12411, 12441-12443, 12463-12467), *Boiruna maculata* (MHNCI 12474, 12475), *Erythrolamprus miliaris* (MHNCI 12340, 12359-12361, 12386-12388, 12425, 12479), *Erythrolamprus poecilogyrus* (MHNCI 5155), *Helicops infrataeniatus* (MHNCI 12423, 12424, 12430), *Oxyrhopus clathratus* (MHNCI 11706, 11711), *Oxyrhopus rhombifer* (MHNCI 11799), *Paraphimophis rusticus* (MHNCI 12335, 12336, 12357, 12358, 12370); *Philodryas agassizii* (MHNCI 14273); *Philodryas olfersii* (MHNCI 11797, 12337-12339, 12346-12352, 12376, 12389, 12421, 12422, 12444, 12445), *Philodryas patagoniensis* (MHNCI 12431), *Thamnodynastes strigatus* (MHNCI 5176, 11716, 11924, 12327-12329, 12342, 12343, 12377, 12428, 12429), *Tomodon dorsatum* (MHNCI 11498, 12368, 12446); **Elapidae:** *Micrurus altirostris* (MHNCI 5138, 12258, 12334, 12426, 12427, 12440, 12471); **Viperidae:** *Bothrops alternatus* (MHNCI 12432, 12434), *Bothrops jararaca* (MHNCI 5139, 11417, 11698-11704, 11707, 11709, 11710, 11712, 11713, 11715, 12292, 12332, 12341, 12353-12356, 12373-12375, 12472), *Crotalus durissus* (MHNCI 11416, 11700, 11705, 11708, 12437, 12438, 12473, 12476-12478); **Anomalepididae:** *Liotyphlops beui* (MHNCI 12390, 12391, 12412-12420, 12447, 12452).